

FARM FACTS

Dry Pea in Saskatchewan

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Introduction

Dry pea (*Pisum sativum L.*) is a pulse crop and a member of the family *Leguminacea*. It was among the first crops cultivated by man and was domesticated about 8,800 BC in the Fertile Crescent near the Tigris and Euphrates rivers in present-day southern Turkey and northern Syria. It is a cool season crop and is widely grown in the cooler temperate zones of the world. The dry pea is grown on about 9 million ha annually and total production ranges from 11 to 12 million tonnes per year. The leading pea producing countries are: Canada, France, China, Russia, Germany, India and Ukraine.

Dry pea was an important crop in Canada at the turn of the century, with Ontario averaging 288,000 ha for the 20-year period, 1883-1902. However, by 1980 only 50,000 ha of the crop was grown in Canada, primarily in the three prairie provinces.

Dry pea was grown on over 900,000 ha in Saskatchewan in 2000, indicating a significant change in cropping practices from the 300 ha reported in 1967.

Dry pea has been the leading alternative crop as farmers move to diversify crop production in Saskatchewan. Both yellow and green cotyledon pea cultivars are grown, with approximately 65% of production in yellow cotyledon types in 2000. Most varieties have a white flower, with recent years seeing an increase in the production of northern-European origin varieties with the semi-leafless leaf type.

The 10-year average yield in Saskatchewan is approximately 2,100 kg/ha (32 bu/ac). The record average yield of 2,600 kg/ha (39 bu/ac) was achieved in 1999 due to the cool, moist summer. Many pea producers in

Saskatchewan expect their pea crops to yield equal to or greater than their wheat crops. The bushel weight for dry pea is 60 pounds. The Saskatchewan Agriculture and Food (SAF) publication, "Specialty Crop Report", provides annually updated statistical information on pea production.

Market Opportunities

International exports of dry pea have averaged approximately 3 million tonnes in the past 5 years. The leading exporting countries are: Canada, France, Australia, Ukraine, USA, and Denmark. (See Figure 1.)

Figure 1. World Dry Pea Exports

Source: FAO, 1998

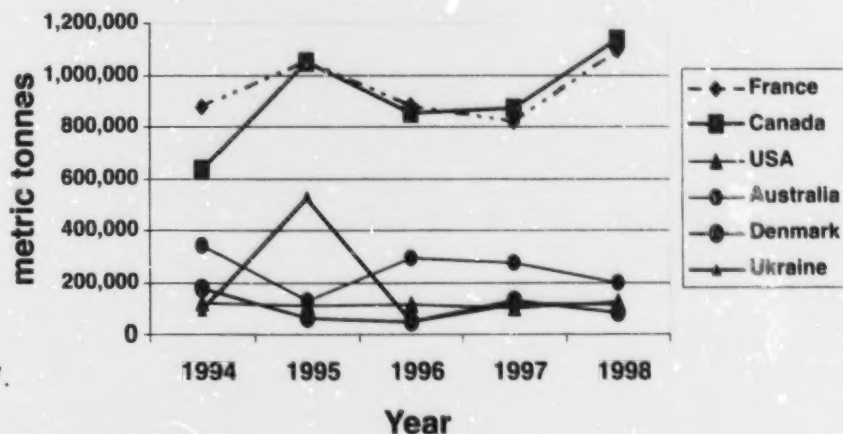
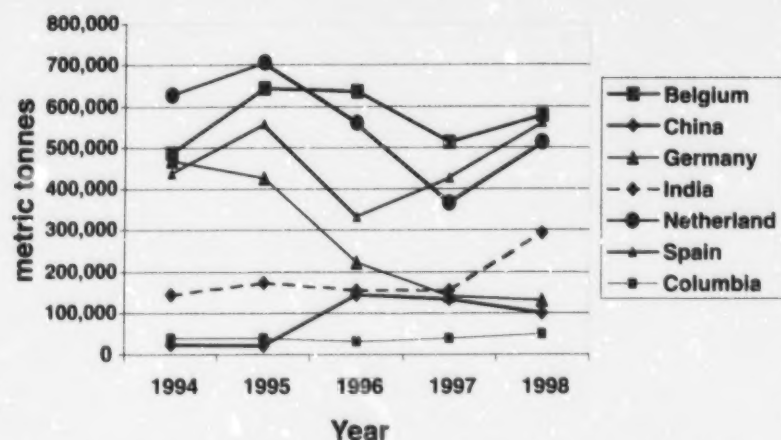


Figure 2. World Dry Pea Imports

Source: FAO, 1998



World imports of dry pea have averaged approximately 2.7 million tonnes in the past 5 years. The leading importing countries are: Belgium, Spain, Netherlands, India, Germany, China, and Columbia. (See Figure 2)

Dry pea is used for human food and livestock feed. The European Economic Community has been a consistent importer of dry pea for many years for use as livestock feed, primarily for swine. Canadian exporters have relied on this market, sometimes shipping more than 700,000 tonnes of feed pea to Europe. The domestic market has recently developed for feed pea, with an increasing proportion of Canadian swine being fed rations that include feed pea. By 1999, up to 400,000 tonnes of dry pea was being utilized in domestic swine rations.

Research results from feeding studies indicate the use of feed pea alone and in combination with canola meal provides an excellent protein and energy source for grower-finisher swine rations. A comprehensive summary of live-

stock ration research showing the value of feed pea as an energy and protein source has been compiled and can be accessed through the internet website of the Saskatchewan Pulse Growers (<http://www.saskpulse.com>).

International swine feeding studies are being completed in countries such as China and the Philippines to encourage the inclusion of feed pea into livestock rations and develop new export markets. Pulse Canada (Winnipeg Manitoba) co-ordinates

export market development for pulse crops including dry pea.

A portion of Canada's dry pea crop is used domestically for human food such as pea soup. The export human consumption market has been growing as more pulse-consuming countries, such as India and Columbia, purchase whole or split pea to provide relatively low cost protein for their growing populations.

Several companies purchase dry pea for feed or human consumption. Some offer production contracts to growers. For a list of dry pea marketing companies refer to the SAF publication, "Saskatchewan Special Crop Marketing Company Synopsis."

Nutritional Characteristics

Information on human nutrition for dry pea consumption is available on the Saskatchewan Pulse Growers website at: <http://www.saskpulse.com> Table 1. contains nutritional data for the use of dry pea in livestock rations.

Table 1. Livestock Nutritional Data (Source: Prairie Feed Resource Centre)	
Digestible Energy (swine)(Kcal/kg)	3480
Crude Protein (%)	22.5
Crude Fibre (%)	5.5
Ether Extract (fat) (%)	1.38
Ash (%)	3.3
Acid Detergent Fibre (%)	8.19
Neutral Detergent Fibre (%)	16.65
Lysine (%)	1.64
Methionine + Cystine (%)	0.48
Threonine (%)	0.94
Calcium (%)	0.11
Phosphorus (%)	0.41

Adaptation

Dry pea has a relatively shallow root system. Pea is best adapted to the moist Dark Brown and Black soil zones, however, it is relatively drought resistant and productive in most years in the Brown soil zone. In pulse crop adaptation trials conducted at seven locations in Saskatchewan funded by the Canada-Saskatchewan Agriculture Innovation Fund (AFIF) Spoke Program, dry pea was shown to be the most widely adapted pulse crop across the agro-ecological zones in Saskatchewan. Poorly drained, cold soils should be avoided, as they favour the development of seedling diseases and root rots.

Dry pea does not tolerate water-saturated or salt-affected soils. Well-drained, clay loam soils are ideal for pea production. Dry pea can tolerate some hot weather or drought stress during flowering but yield reductions may occur.

Rotational Considerations

Dry pea production is often most successful when grown in rotation with cereals such as barley, spring or durum wheat. Research carried out at the Semiarid Prairie Agricultural Research Centre at Swift Current, Saskatchewan indicates pea roots reach a depth of approximately 0.75 to 1 m, compared to wheat at 1.5 to 2 m. Dry pea is able to efficiently utilize soil moisture in stubble conditions when the top metre of the soil profile has been

recharged by fall or spring rains. Soil moisture below the depth of 1 m is left in reserve for the following crop. In crop rotation tests, wheat and durum wheat grown on dry pea stubble produced higher yields and higher % protein compared to wheat grown on wheat stubble.

Research indicates that sowing dry pea into standing cereal stubble helps protect the land from erosion and provides shelter for newly emerging seedlings. Late spring frosts that occurred in 1998 and 2000 revealed that leaving cereal straw in clumps or piles in the field increases frost injury to newly emerged pea seedlings. Spreading the straw evenly in the field helps to prevent spring frost injury and avoid mechanical problems such as air-seeder plugging or header plugging of harvest equipment.

Another benefit to rotating pea with cereal crops is the interruption of pest cycles. Most cereal diseases do not affect pulse crops. Soil-borne root rots in continuous cereal systems may cause average yield losses up to 10%. Grasshoppers do not thrive in pea crops and dry pea is not a host for wheat midge.

Pea is susceptible to mycosphaerella blight (ascochyta) and sclerotinia (see Disease Control), and careful consideration must be given to crop rotation to avoid these diseases. Where mycosphaerella blight is a problem, pea production should be avoided more often than one year in three in the same field. In areas where

sclerotinia is a problem, avoid seeding susceptible broadleaf crops (canola, sunflower, hemp, chickpea, pea, lentil) more often than one in four years in the same field.

Highly fertile soils, such as fallow fields high in available nitrogen (N), may result in excess vegetative growth at the expense of seed production.

Pea is a poor competitor to weeds so selection of a clean field is important. Perennial weeds such as Canada thistle and sow thistle should be controlled in the years prior to pea production. Dry pea is susceptible to the soil residues of some herbicides used in previous years. It is important to record herbicide use each year and avoid seeding dry pea in fields with the following herbicide history: TORDON®, GLEAN® > 5 years (persistence is extended when soil pH is 7.5 or greater); ALLY®, AMBER® 4+years (persistence is extended when soil pH is 7.5 or greater); ACCORD® 2 years; MUSTER®, FLAX MAX ULTRA®, ASSERT®, LONTREL®, UNITY®, CURTAIL®, PRESTIGE®, PREVAIL®, BANVEL® (non-crop summerfallow rate) 1 year; fall applications of RUSTLER®, BANVEL, high rates of 2,4-D; and spring application of 2,4-D at low rates used for winter annual control. The SAF publication, "Guide to Crop Protection" contains more information about herbicides and their soil residual properties.

Irrigation

Dry pea can be successfully grown under irrigation. Early maturing, short-vined varieties are best suited to this type of production. Agronomy of irrigated pea is similar to dry land production. Yields can be much higher than dry land production, however, special attention must be paid to prevent losses due to disease and lodging. The Canada-Saskatchewan Irrigation Diversification Centre at Outlook, Saskatchewan compares dry pea varieties under irrigation conditions and provides recommendations for the proper production of irrigated dry pea.

Inoculation

Dry pea inoculated with the appropriate strain of *Rhizobium* bacteria is able to fix a portion of its nitrogen (N) requirement from the atmosphere. For this to occur, the seed or the soil surrounding the seed must be inoculated. The rhizobia enter the root hairs and induce nodule formation. The plant provides energy for the bacteria living inside the nodules and, in return, the rhizobia convert atmospheric N to plant useable forms. Maximum benefit is derived if the supply of available soil N is low and the soil moisture and temperature levels are adequate for normal seedling development from the time of seeding until seedlings are well established.

The *Rhizobium* bacteria die if they are exposed to stress such as high temperature, drying winds

or direct sunlight. Therefore, both inoculant products and inoculated seed should be treated with care and every effort must be made to plant the inoculated seed into moist soil as soon as possible after treatment.

Inoculants are sensitive to granular fertilizer, so banding fertilizer to the side or to the side and below the seed is preferred. Inoculants are also sensitive to some seed-applied fungicides (see Disease Control). When using a combination of fungicide and inoculant, apply the fungicide to the seed first, allow it to dry, and apply the inoculant immediately prior to seeding. Granular inoculants are less affected by dry seedbeds and seed-applied fungicides than other forms of inoculants.

High available soil N levels (over 55 kg N/ha) inhibit N fixation since the pea plant will preferentially use the soil N rather than fix N. *Rhizobium* bacteria can live in the soil for a number of years, however, the most efficient N fixing bacteria may not be among those that survive. For this reason, most experienced dry pea producers use an inoculant on their pea crop every year.

The SAF publication "Inoculation of Pulse Crops" provides more detailed information on the use of N fixing inoculants.

Fertilization

Nitrogen - Soil testing is a good investment. A properly conducted soil test can provide an excellent guideline for dry pea

fertility requirements. Nitrogen (N) is necessary for high pea yields, but generally, N fertilizer application is not required. When properly inoculated with an appropriate *Rhizobium* inoculant, dry pea can derive up to 80% or more of its N through N fixation. The remaining N comes from what is available in the soil at seeding, plus N that is released from the soil during the growing season.

Nodule formation and subsequent N fixation are very sensitive to external N sources including fertilizer and available soil N. As the supply of N from soil and fertilizer to the plant increases, the amount of N fixed decreases. When the combined levels of soil and fertilizer N reach 28-40 kg/ha (25-35 lbs/ac), any additional N will reduce nodulation and N fixation. Combined levels of soil and fertilizer N greater than 55 kg/ha (50 lbs/ac) can prevent nodulation and N fixation.

It can take three to four weeks after planting before nodules are fully functioning. In soils with N levels less than 11 kg/ha (10 lbs/ac), early plant growth may be poor and plants may appear yellow due to a N deficiency prior to the onset of active N fixation. This early N deficiency can be corrected by adding low levels of starter N at seeding. However, it is important to remember that fertilizer N applications that result in combined N levels (i.e., soil and fertilizer) greater than 35 kg/ha (30 lbs/ac) can be counterproductive and reduce nodulation and N fixation. Although high levels of starter N

may appear to help the crop overcome a N deficiency during early crop growth stages, final seed yields may not increase. Monoammonium phosphate (ex. 12-51-0) provides the small amount of N needed for early plant growth and, depending on the soil test, may provide all the starter N required. The SAF publication, "Inoculation of Pulse Crops", includes information on what to do if the crop fails to fix N through inoculation.

Phosphorus - Dry pea has a relatively high requirement for phosphorus (P). Phosphorus is needed to promote the development of extensive root systems and vigorous seedlings. Encouraging vigorous root growth is an important step in promoting good nodule development. Phosphorus also plays an important role in the N fixing process. Pea planted on soils testing low in available P or under cool or wet conditions may respond dramatically to P fertilizer. As with cereals, yield responses are not always achieved when applying P in the form of phosphate fertilizers. However, a pea crop may benefit from increased frost tolerance, resistance to disease, improved nodulation and N-fixing and drought tolerance as a result of a P application.

The maximum safe rate of actual phosphate applied with the seed is 17 kg/ha (15 lbs/ac) in a 2.5 cm (1 in) spread and 15-18 cm (6-7 in) row spacing under good to excellent moisture conditions. Rates of seed-placed phosphate fertilizer must be reduced if the seed bed has less

than ideal moisture conditions. Higher rates of phosphate fertilizer placed in the seed row with narrow openers like discs or knives can damage the emerging seedling and reduce the stand. If higher phosphate rates are required, banding the fertilizer away from the seed (sideband or to the side and below) or the use of the product Jumpstart® should be considered. If sidebanding is available, sideband all the phosphate fertilizer especially when using narrow openers.

Sulphur - A 40 bu/ac pea crop requires about the same amount of sulphur as does a 40 bu/ac wheat crop, which is approximately 9-11 kg/ha (8-10 lbs/ac). Soils testing low in available sulphur should have this deficiency corrected using ammonium sulphate, which contains sulphur in a plant available form. Most research indicates no yield response to the addition of sulphate-sulphur fertilizer except in fields testing very low in sulphur. The SAF publication, "Sulphur Fertilization in Crop Production" contains more details for correcting sulphur deficiencies.

Potassium - Dry pea has a high demand for potassium (K), and is about 135-165 kg/ha (123-150 lb/ac) K₂O for a 50 bu/ac crop. Fields low in K should be corrected based on soil test recommendations. Banding K fertilizer is more effective. For more information see the SAF publication, "Potassium fertilization in crop production."

The SAF publication, "Guidelines for safe rates of fertilizer applied with the seed", provides

more information about fertilization of dry pea.

Seeding

The use of high quality seed is important for successful pea production. Seed-borne diseases such as mycosphaerella blight (ascochyta) can reduce seedling vigor and lead to yield and quality losses. It is important to have pea seed tested by an accredited seed test laboratory for germination, purity and disease levels. Do not use seed from a pea crop that had a pre-harvest application of glyphosate as uneven germination and poor seedling vigour may occur.

Pea seed is highly susceptible to mechanical damage during harvest, handling or seeding operations. Dry seed (14% moisture or less) is brittle and can easily crack or split leading to reduced germination. Moisturizing the seed with water before seeding can reduce mechanical injury. Information on moisturizing the seed can be obtained from The Prairie Agricultural Machinery Institute (PAMI) factsheet called "Moisturizing Pulses to Reduce Damage".

A firm, weed-free seed bed on well-drained soils is best for dry pea production. Stony fields should be avoided or rolled after seeding to bury loose stones and smooth soil ridges that may cause harvest problems (see Land Rolling). Excessive soil packing should be avoided especially in heavy or wet soils prone to crusting.

The recommended seeding depth for dry pea is 3-8 cm (1-3 in). It is critical that seeds are placed into moist soil.

The target plant population for dry pea is 85 plants/m² (8/ft²). Crop stands of 85 plants /m² provide better competition against weeds and will result in higher yields. Thinner stands are capable of producing high yields provided that weed control is excellent. Crop stands of greater than recommended density may increase the risk of foliar disease infection, especially in wetter areas. Surveys of commercial pea crops in Saskatchewan reveal that this target population is rarely achieved.

Optimum seeding rate depends on the seed size. For example, the large-seeded yellow pea variety Alfetta has an average seed size of 290 g/1000 seeds. The following formula should be used to determine the target seeding rate for dry pea.

The recommended seeding date for dry pea is as early as possible in the spring (mid-April to mid-May) provided the average soil temperature at depth of seeding has reached 5°C and the soil is not excessively wet. This means that dry pea is often the first crop seeded in the spring. Seeding early advances maturity of the crop, reducing the probability of damaging high temperatures during the flowering period. Pea seedlings can withstand some late spring frost. Even if the frost is severe enough to kill the main shoot, regrowth from buds at one of the nodes at or below the soil surface can

$$\text{Seeding rate (lb/ac)} = \frac{(\text{population/ft}^2 \times 1000 \text{ seed wt.g}) \times 10}{\% \text{ field emergence or survival}}$$

$$\text{Example: Alfetta (8 plants/ft}^2 \times 290 \text{ g)} \times 10 = 244 \text{ lb/ac seeding rate}$$
$$95\% \text{ seed survival}$$

occur, but with a resulting delay in maturity. Early seeding, in general, results in higher yields.

The use of a registered fungicide seed treatment (see Disease Control) for the control of seed rot and seedling blight in pea should be considered if seeding into cold wet soils in early spring or if the seed has been cracked or peeled. For best results, apply the fungicide first, allow it to dry, and apply the N fixing inoculant just prior to seeding.

Land Rolling

A land roller can be used in dry pea fields to provide a smooth and level surface for harvest. Land rolling can be done before or after the crop emerges. Research done by Alberta Agriculture, Food and Rural Development indicates that land rolling after the emergence of pea can be successfully completed up to the five-node stage without significant yield loss. Land rolling past this stage can damage plants, increase the spread of foliar diseases, and reduce yields. Best results are obtained if rolling is completed before the pea crop emerges. Rolling should not be done on wet soils or when the crop is damp or stressed by extreme heat, frost or herbicide application.

Varieties

Both yellow and green cotyledon pea varieties are grown in Saskatchewan. Most dry pea varieties have white flowers and are suitable for the human consumption or livestock feed markets. Most commercially produced varieties have the semi-leafless leaf type, with tendrils instead of leaflets. The tendrils of adjacent plants intertwine to provide better support (standability) for the entire canopy. This characteristic can reduce foliar disease development and ease harvest under good growing conditions. The canopy of semi-leafless varieties may be less competitive to weeds. It is important to establish the recommended plant density for semi-leafless types.

Marrowfats are blocky shaped, very large-seeded green cotyledon pea utilized in the specialty snack food market in Asia. Some production of purple-flowered varieties with coloured seed coats (Maple pea) also exists. Maple pea is used to feed racing pigeons. The SAF publication, "Varieties of Grain Crops" provides an annually updated list of dry pea varieties. Variety characteristics of yield, maturity, vine length, seed weight, resistance to disease, seed coat breakage, lodging and bleaching are compared.

Weed Control

Pea crops do not compete well against weeds, so good weed control using suitable cultural controls and/or herbicides is essential and often the most important consideration for profitable pea production. An integrated approach to weed control combines preventative and cultural measures (such as the use of clean, healthy seed, crop rotations with diverse agronomic traits and good sanitation practices) with the effective use of selective herbicides.

Weed control in dry pea begins in the year prior to production. An application of pre-harvest glyphosate in the previous year's crop, fall herbicide application for winter annuals, and selection of a field where weed problems can be controlled culturally or with herbicides registered for use in dry pea, are important points to note when planning dry pea production. Avoid areas where perennial weeds such as Canada thistle or sow thistle may be a problem. Clean harvest and seeding equipment to avoid the spread of weed seeds into new fields. Pea is susceptible to the soil residues of some herbicides used in previous years. (See Rotational Considerations)

Dry pea is slow to develop, so early seeding and achieving optimum plant densities, are important to enhance competition to weeds. No new weeds should be introduced with the seed. A pre-emergence burn-off treatment with glyphosate can be used to control early emerging weed

seedlings. Harrowing between seeding and emergence of the pea crop can control newly emerged weed seedlings and remove weeds that escaped previous tillage operations. Harrowing should be avoided as the crop emerges and for several days after emergence to permit effective rooting and stand establishment. Post-emergence harrowing must be viewed as a drastic measure, and a higher seeding rate should be used to offset the plant losses during harrowing. Post-emergent harrowing should be done under warm, dry conditions to improve weed control and to prevent the spread of diseases.

Pea plants are more competitive with annual weeds if they emerge rapidly and cover the soil surface before the weeds emerge. If post-emergence herbicides are used they should be applied before the pea plant reaches the five-node stage for best coverage and control of weeds with minimal damage to the crop. Crop injury due to late herbicide application is a common problem. In short stature varieties or adverse growing conditions, a pea plant can reach the five-node stage and be only 7.5 cm (3 in) tall.

Research conducted at Agriculture and Agri-Food Canada and at the AFIF Spoke Sites in Saskatchewan has demonstrated the importance of early weed removal in pea production. Annual weeds were removed from dry pea crops at intervals of 1, 2, 3, and 4 weeks after crop emergence. Pea yields declined

by 0% after 1 week, 7% after 2 weeks, 12% after 3 weeks, and 26% 4 weeks after crop emergence.

Thoroughly clean sprayers following the label directions of the previous herbicide before using the sprayer to apply herbicides in dry pea, as very small amounts of residue of many herbicides can cause significant crop injury.

Pre-Harvest Weed Control

A pre-harvest application of glyphosate for the control of perennial weeds is registered for use on dry pea. This treatment will provide some crop dry-down, but this benefit is inconsistent and is unlikely to occur under cool, wet conditions. Apply when the crop has 30% or less grain moisture (75-80% of pods are tan). Do not apply glyphosate to pea crops destined for planting seed because irregular germination and seedling development can occur. The SAF publication, "Guide to Crop Protection" provides information on the herbicides registered for use in dry pea.

Insect Control

The pea aphid adult is small - about 4 mm (0.15 in) long, light-green and long-legged. The insect may be wingless or have prominent, nearly transparent wings. Although pea aphids rarely survive winter in Saskatchewan, they may overwinter as an egg attached to the stems or leaves of alfalfa or clover. In

early spring the eggs hatch. The young aphids feed on the newly emerged alfalfa or clover plants. During May and June, depending on weather and host plant conditions, the insects develop wings and fly, with the aid of wind currents, to pea fields.

The majority of aphids in pea fields are blown in on warm southerly winds from the United States in June or early July. The pea aphid weakens the plant directly by sucking its sap, and in warmer countries, is responsible for transmitting virus diseases. Economic losses can occur if there are more than 10 aphids per plant during the period between formation of the tenth node and appearance of the first flower. Population estimates should be calculated by averaging the counts taken from at least five separate areas of the field. To avoid reoccurrence of the problem after spraying, delay application of insecticide until late flowering. One application per season should give satisfactory control. Pea aphid populations usually decrease drastically in mid to late August due to drying of the crop, parasitic wasps and disease.

Cutworms can occasionally attack pea crops. Economic thresholds are approximately 2-3 cutworms /m².

Grasshoppers can attack dry pea crops, however the risk is not severe. The annual grasshopper forecast map is published by SAF and indicates the risk of grasshopper outbreaks in each crop district. Grasshopper damage is most likely to affect seedlings along ditches and road allowances.

Although grasshoppers can severely damage pea seedlings, they are not their preferred food. Usually, grasshopper infestations of 10/m² do not cause economic losses in dry pea.

For information on registered insecticides in dry pea, consult the SAF publication, "Guide to Crop Protection."

Disease Control

Dry pea crops are subject to a number of diseases that can reduce yield and quality. Infection can arise from a variety of sources. Seed-borne, soil-borne and residue-borne diseases can be minimized through preventative management. Disease prevention recommendations include:

1. Use effective crop rotations - Plant dry pea only once every 4 years in the same field. Continuous production of broadleaf crops can increase some seedling diseases and sclerotinia.
2. Use the best seed available - a seed test will indicate the presence of seed-borne diseases.
3. Use of a registered fungicide seed treatment may be warranted especially if seeding early into cool, wet soils.
4. Seed early.
5. Monitor fields for diseases.

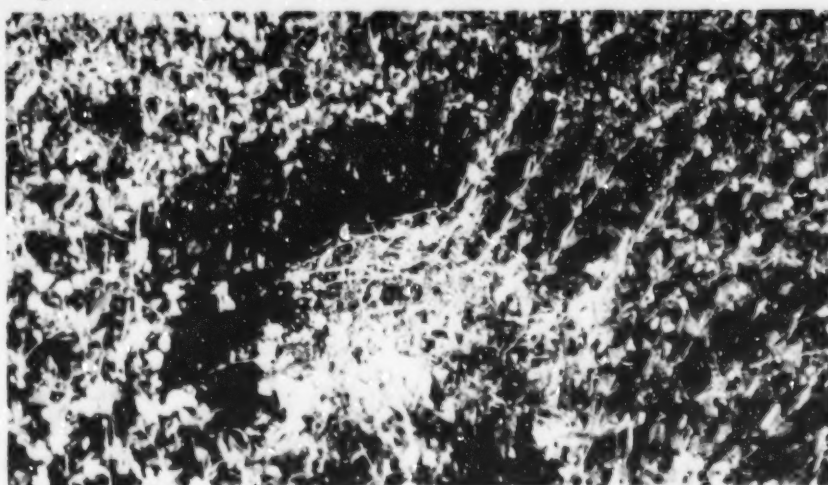
Agriculture and Agri-Food Canada, Saskatoon, Saskatchewan has developed a website which describes pulse crop diseases. This information is based on research funded by AFIF and is located at http://paridss.usask.ca/specialcrop/pulse_diseases/index.html

Mycosphaerella blight - This fungal disease is also known as ascochyta blight. There are three *Ascochyta* species that infect dry pea. In Saskatchewan, the most common species is *Ascochyta pinodes*. The sexual stage of this species is called *Mycosphaerella pinodes* which produces air-borne spores. Infection can be caused by inoculum that originates from infected pea stubble in neighbouring fields. Thus crop rotation is not a guarantee against infection.

Early symptoms of mycosphaerella blight are small purplish-black, irregularly-shaped spots on lower leaves, stems and pods. These spots turn brown or black, grow together and spread up the plant. The impact on yield depends on the timing of initial infection and weather conditions. If the source of the infection originates within the same field, the disease can develop early and the likelihood of loss is greater. If the initial infection occurs at the base of the plant, footrot (see Figure 3.) can occur and the plant may prematurely lodge and die.

Seed infection is an important source in introducing mycosphaerella to an area. However, seed transmission is of less significance than transmission from infected pea stubble. No commercial dry pea varieties are resistant to mycosphaerella blight, however some varieties are more susceptible than others. See the SAF publication, "Varieties of Grain Crops" for disease resistance ratings of pea varieties. BRAVO 500® is registered for the post-emergence control of

Figure 3. Mycosphaerella blight causing footrot on dry pea



mycosphaerella blight in dry pea.

Sclerotinia stem rot -

(*Sclerotinia sclerotiorum*) This disease attacks many broadleaf crops, but is most severe on sunflower, dry bean and canola. It overwinters as sclerotia - small black resting bodies - in the soil, apart from the host. Sclerotia may remain viable for three to five years.

Infection can take place in two ways. Firstly, when in close contact with the pea root, sclerotia may germinate and cause infection at the base of the plant. Secondly, under a dense plant canopy, sclerotia will germinate and develop tiny mushroom-like structures that produce spores. These spores colonize dead plant material such as fallen flower petals or hail-damaged leaves. Spores can be windblown, so planting pea next to previously infected fields can assist in spreading the disease.

Once infection has occurred, it can spread very quickly by plant-to-plant contact, especially when there is moisture under a

heavy crop canopy. If infection occurs late in the growing season, there may be little effect on yield, however, the build up of sclerotia in a field may have a negative impact on later broadleaf crops. There are no fungicides registered for the control of sclerotinia in pea.

Root Rot - Root rotting fungi (*Pythium*, *Rhizoctonia*, *Botrytis*, and *Fusarium* species) can attack any part of the root system, sometimes even a short distance above the soil surface. Young seedlings infected with root rot appear yellow, stunted and often die. APRON FL*, Agrox B-3*, Agrox D-L Plus*, DLC*, Captan Flowable*, DCT*, Thiram 75WP*, and VITAFLO 280* are registered seed treatments in pea. Seed treatments offer protection to the developing seedling, especially under cool, wet conditions when emergence may be delayed. Seed treatments can reduce the viability of nitrogen-fixing *Rhizobium* inoculants. Fungicide seed treatments should be applied first, allowed to dry, and the inoculant

should be applied just prior to seeding.

Crop rotation is also useful in preventing the build up of soil-borne fungal organisms. Continuous production of broadleaf crops in the same field can lead to a build up of root rot and seedling rot diseases.

Bacterial blight -

(*Pseudomonas syringae* pv. *pisi*)

Infections of this disease are not common in Saskatchewan. It is primarily seed-borne so obtaining seed free of bacterial blight is important. The bacteria can also over winter on crop residues, so crop rotation is an important method of disease control. Symptoms start as small water-soaked spots on leaves, stems and pods. During wet weather, a creamy white ooze may appear on the spots. When this material dries, the spots become dark brown and may appear shiny. If held up to the light these leaf spots appear translucent. The bacteria is spread by rain splash. Hail or other physical injury to the plant may favour infection.

Powdery mildew - (*Erysiphe polygoni*) Infection of pea crops usually begins about mid-July. Pea crops seeded in early spring have often progressed past the stage of economic impact as pods and seeds are already formed before the disease begins. Delayed seeding increases the risk of an economic impact.

Most varieties of dry pea commonly grown in Saskatchewan are susceptible to powdery mildew. Plant breeders are selecting for resistance to pow-

dery mildew in most new dry pea lines. The SAF publication, "Varieties of Grain Crops" provides a list of pea varieties with resistance to powdery mildew.

Powdery mildew is favoured by periods of warm, dry, daytime conditions when nights are cool enough to cause dew formation. Rain showers actually disrupt the spread of powdery mildew.

Symptoms include the development of white, powdery spots on lower leaves and stems which can quickly spread to the entire plant. Severely affected crops are covered in a white mat of powdery spores and may appear to have a bluish or silvery sheen. The underside of infected leaves turn yellow below the powdery infection. The disease can reduce yield, delay maturity, and reduce uptake of desiccants.

KUMULUS® DF is registered for the control of powdery mildew on dry pea. This product, which is 80% sulphur, is a protectant fungicide and does not cure leaves already diseased. Application must be made prior to infection or as soon as the first sign of powdery mildew is evident. Repeat applications may be required at 7 to 10 day intervals if the same weather conditions that favour the disease persist. Growers who have used KUMULUS DF also recommend that sprayers be thoroughly flushed to prevent plugging.

Other Diseases - Other fungal disease of minor importance include downy mildew, anthracnose, septoria blight and rust. Virus-like diseases can also occur in dry pea. They are spread by

feeding aphids with the exception of one; pea seed-borne mosaic virus (PSbMV).

Harvesting

Great care should be taken when harvesting dry pea for the human consumption market. Pea samples that contain excessive amounts of foreign material, cracked, peeled, or discoloured seeds are suitable only for the feed market. Soil stuck to the seed is called earth tag and is a common down-grading factor in dry pea. This may occur during combining, when moisture from weeds or heavy dew causes soil or dust to stick to the seed.

Pea crops should be monitored closely to determine the proper stage for harvest. Generally, plants mature from the bottom up. Crops are nearing maturity when the bottom 30% of pods are ripe, the middle 40% of pods and vines are yellow coloured, and the upper 30% of pods are turning yellow. This is the proper stage for crops to be swathed or desiccated.

The most important grading factor for the human consumption market in green cotyledon pea is seed colour. The maximum allowed bleach level for human consumption green pea is 2%. Green varieties are susceptible to bleaching as they near maturity. Bleaching of seed is caused by high humidity, bright sunshine and warm temperatures. For this reason, extra care should be taken to harvest green pea varieties as soon as possible.

Dry pea may be swathed prior to full maturity or straight-combined at full maturity. The swather or straight-cut header should be equipped with vine lifters (pick-up guards) and/or a pick-up reel to ease the harvest of lodged or tangled crops.

The swather can also be used to cut the crop at full maturity. The combine should follow immediately behind the swather, as even moderate winds can damage pea swaths.

A desiccant herbicide can be applied to pea to kill green weeds and speed the dry down of the crop. This treatment does not mature the crop, but can eliminate the need for swathing and dry down green weeds which interfere with harvesting. Desiccation is also used on green pea varieties to reduce the risk of bleaching by shortening the time the crop is left in the field.

REGLONE® and REGLONE PRO® are registered desiccants for ground or aerial application on dry pea. REGLONE should be applied to pea crops when 75%-90% of the pods have turned yellow. Avoid spray drift onto adjacent crops and tree rows. Germination of seed is not affected. See the SAF publication, "Guide to Crop Protection" for more information about the use of desiccants.

Straight-cutting dry pea has gained popularity due to the increased use of land rollers, development of flex-headers, and the introduction of varieties with improved standability. The crop is permitted to completely ripen

and harvested at approximately 18-20% seed moisture with the combine equipped with a flex-header. An alternative method involves the use of a Rake-Up® or modified Sund® pick-up at full maturity. These pick-ups have a positive motion that break the brittle, ripe vines off at the soil surface, eliminating the need to swath.

Mature pea pods can shatter their seeds very easily when dry, thus care must be taken to reduce shattering during swathing or straight combining. Shattering can be reduced by harvesting during the humid part of the day, and by slowing the reel or pick-up speed to keep the action against the crop to a minimum.

Dry pea should be combined at 18-20% seed moisture content to reduce the risk of seed cracking or peeling. Low combine cylinder or rotor speeds are required to reduce seed cracking. Speeds of 300 to 600 rpm are normally used, depending on cylinder/rotor diameter and the moisture content of the pea sample. An initial concave setting of 0.6-1.5cm (0.25-0.6 in) clearance at the front and 1.2cm (0.5 in) at the rear is recommended. Combine and grain augers should be operated full and at low speeds to reduce cracking and splitting seeds.

There is an increased risk of combine fires when harvesting dry pea especially if the crop has suffered a serious infection of powdery mildew.

Post-Harvest Pea Residue Management

Dry pea and other pulse crops extend and diversify crop rotations, increase nitrogen availability, improve soil tilth, and contribute to soil organic matter. Pea residue breaks down more rapidly than the residues of many other crops such as wheat or canola, providing nutrients to subsequent crops.

Dry pea residue must be handled properly to reduce seeding problems the following year. If the straw is being used for livestock feed, it should be removed quickly after combining to retain feed quality. If not, pea straw should be chopped and evenly spread during harvest. Bunched and piled pea straw can cause extensive plugging of cultivation and seeding equipment the following spring. Some producers report that the use of heavy harrows can be beneficial to spread pea residue before seeding. Others use disc implements to chop and spread the residue, however this practise may increase soil erosion. Many find that direct seeding equipment with narrow openers and good trash clearance can seed directly into pea residue, provided the straw has been chopped and evenly spread during the previous harvest.

Storage and Handling

Samples containing green weed seeds and other high moisture materials should be cleaned as soon as possible to prevent

heating. Producers can employ the services of a number of companies in Saskatchewan which clean, bag and handle pea, making it suitable for domestic and export human consumption markets.

Moisture levels up to about 16% and temperatures below 15°C are considered safe for pea. The use of aeration fans to reduce moisture and temperature will improve storage.

If supplemental heat drying is necessary, air temperatures should not exceed 43°C to preserve germination, and the sample should not be dried more than 4 to 5 percentage points per pass through the dryer. Temperatures of up to 70°C should only be used for drying feed pea.

A great deal of respiration occurs in pea seed after it is placed in storage. Extra care should be taken to monitor the grain inside the bin for moisture build-up or spoilage. Aeration fans can be used to cool the grain in the fall and warm it in the spring to reduce moisture condensation in the bin. Pea seed is more susceptible to cracking and peeling if handled at temperatures less than -20°C.

The Canadian Grain Commission (CGC) sets standards for grading dry pea in Canada. For more information on pea grading standards, contact your grain buyer or the CGC office in your area. The CGC website address is: <http://www.cgc.ca/main-e.htm>

Economics of Production

The SAF publication, *Crop Planning Guide - Alternative Crops*, includes information on projected costs of production and expected returns of yellow and green food pea and feed pea in Saskatchewan.

Marketing

A list of dry pea brokers and traders is available in the SAF publication, *Saskatchewan Special Crop Marketing Company Synopsis*.

The Winnipeg Commodity Exchange (website address: <http://www.wce.mb.ca/>) offers Feed Pea futures contracts.

Additional Information Sources

- Saskatchewan Agriculture and Food Internet website: <http://www.agr.gov.sk.ca/>
- Inoculation of Pulse Crops, SAF
- Guide to Crop Protection, SAF
- Guidelines for safe rates of fertilizer applied with seed, SAF
- Principles and Practices of Crop Rotation, SAF
- Soil Improvement with Legumes, SAF
- Sulphur Fertilization in Crop Production, SAF
- Potassium Fertilization in Crop Production, SAF
- Varieties of Grain Crops for Saskatchewan, SAF
- Crop Planning Guide, Alternative Crops, SAF
- Saskatchewan Special Crop Marketing Company Synopsis, SAF
- Specialty Crop Report, SAF
- Ascochyta Blight in Pulse Crops, SAF

Canada-Saskatchewan Irrigation Diversification Centre at Outlook, SK. (306) 867-5400

Pulse Production Manual, Saskatchewan Pulse Growers, Saskatoon, SK. (306) 668-5556 Website address: <http://www.saskpulse.com/>

Pulse Crop Diseases Website, AAFC, Saskatoon, SK.
http://paridss.usask.ca/specialcrop/pulse_diseases/index.html

Prairie Crop Protection Planner Software, University of Saskatchewan (306) 966-5565

Moisturizing Pulses to Reduce Damage, Prairie Agricultural Machinery Institute, Humboldt, SK (800) 567-7264

Pulse Canada, Winnipeg, MB (204) 925-4450

Website address:
www.pulsecanada.com/

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